

Tools for Tomorrow's Science and Technology Workforce: MATE's 2006 ROV Competition Sets Students' Sights on Ocean Observing Systems

Jill Zande¹, Blanche Meeson², Susan Cook³, and George Matsumoto⁴

¹Marine Advanced Technology Education (MATE) Center
Monterey Peninsula College
980 Fremont Street
Monterey, CA 93940

²Ocean.US
2300 Clarendon Blvd.
Suite 1350
Arlington, VA 22201-3667

³Consortium for Oceanographic Research & Education
1201 New York Avenue, NW
Suite 420
Washington, D.C. 20005

⁴Monterey Bay Aquarium Research Institute
7700 Sandholdt Road
Moss Landing, California 95039-9644

Abstract – Teams participating in the 2006 ROV competition organized by the Marine Advanced Technology Education (MATE) Center and the Marine Technology Society's (MTS) ROV Committee experienced first-hand the scientific and technical challenges that many ocean scientists, technicians, and engineers face every day. The competition tasked more than 1,000 middle and high school, college, and university students from Newfoundland to Hong Kong with designing and building ROVs to support the next generation of ocean observing systems.

Teaming up with the National Office for Integrated and Sustained Ocean Observations, Ocean.US, and the Ocean Research Interactive Observatory Networks (ORION) Program, the competition highlighted ocean observing systems and the careers, organizations, and technologies associated with ocean observatories. The student teams were challenged to develop vehicles that can deploy, install, and maintain networks of instruments as well as to explore the practical applications and the research questions made possible by observing systems.

BACKGROUND

Our nation's interest in and dependence on the ocean environment – for energy, food, telecommunications,

transportation, and exploration – is increasing [1]. It is estimated that twenty percent of our nation's economy is based on ocean activities, and that one in six jobs is ocean-related [2]. These figures will undoubtedly continue to rise, especially as more and more of the U.S. population moves to the coast and is increasingly affected by ocean-related events such as Hurricane Katrina, which devastated Gulf Coast communities.

Yet many students are unable to make the connection between the ocean and their every day lives. Many students, and instructors, too, are unaware of the wealth of ocean-related careers that exist and the knowledge and skills needed to work in them. This lack of awareness translates into a lack of available educational programs and training opportunities [3]. Particularly lacking are educational programs that focus on the engineering and technology that support ocean activities, especially at the middle and high school level where students are just beginning to think about their career paths. A number of electronics, machining, and other "shop" programs have been and continue to be phased out at schools and colleges because of funding cuts and a shortage of technical expertise to support them. This is especially alarming when our reliance on technology for national security, transportation and commerce, energy and exploration activities, telecommunications, recreation and tourism, fisheries and

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 01 SEP 2006		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Tools for Tomorrows Science and Technology Workforce: MATEs 2006 ROV Competition Sets Students Sights on Ocean Observing Systems				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Marine Advanced Technology Education (MATE) Center Monterey Peninsula College 980 Fremont Street Monterey, CA 93940				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM002006. Proceedings of the MTS/IEEE OCEANS 2006 Boston Conference and Exhibition Held in Boston, Massachusetts on September 15-21, 2006					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 5	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

aquaculture, search and rescue, environmental assessment and regulation, and research has never been greater [1].

The lack of hands-on technical education programs leads to a shortage of qualified individuals to support the ocean industry [1, 4]. As Bruce Gilman, former president and CEO of Sonsub, Inc., one of the largest contractors for the oil and gas industry, states, “Sonsub and other marine contractors have an increasing requirement for skilled people with training in marine technology. Filling this need is a serious problem for companies such as ours.” Jerry Streeter, current president of MTS, underscored this statement during his 2005 “state of the society” address. According to Streeter, the majority of technical professionals currently working in the offshore industry are over the age of 50 [5]. Qualified individuals will be needed to replace those professionals as they retire – which represents both an opportunity and a challenge for today’s educational system.

BRIDGING THE GAP BETWEEN EDUCATION AND THE WORKPLACE

The MATE Center and the MTS ROV Committee created the ROV competition program as a way to help meet this challenge, increase awareness of ocean occupations, and infuse relevant technical skills and information into mainstream education. The program was also designed to promote the understanding and development of the skills and abilities needed to support ocean activities, and to help bridge the gap between the educational system and the marine workplace.

Since 2001, the MATE Center and the ROV Committee have partnered with industry, education, professional society, government, and public aquarium organizations to engage more than 3,000 students and instructors from middle schools, high schools, home schools, colleges, and universities in developing ROVs for mission tasks that simulate the working environment. Designing and building a vehicle to successfully complete a competition mission involves a practical, working knowledge of math, physics, electronics, hydraulics, and engineering. It also requires budgeting, setting deadlines, documenting procedures and results, project management, communication, teamwork, critical thinking, continual problem solving, and producing deliverables on time – just like the real world.

OCEAN OBSERVATORIES: TOOLS FOR TOMORROW’S SCIENCE & TECHNOLOGY WORKFORCE

Each year the competition focuses on a new theme in order to expose students and instructors to a different aspect of the ocean workplace and the scientific and technological advancements that are taking place.

The 2006 competition focused on ocean observing systems as a way to increase understanding of observatories and to help students to see how their technical, problem solving, and teamwork skills can be applied to supporting these systems in the real world.

All total, more than 150 student teams from around the world developed vehicles for underwater mission tasks based on the operational aspects of ocean observatories. For example, teams’ piloted their ROVs to deploy and network instruments for power and communications and to recover equipment for maintenance and repair.

In addition to the underwater challenges, the teams prepared technical reports that documented the process they went through to design and build their vehicle, including the challenges faced and lessons learned. The teams also created poster displays to visually communicate information about their ROV and their team.

As part of their technical reports and poster displays, the teams were asked to research and report on a career, organization, or technology that supports ocean observing systems. The following are some examples of how teams addressed that requirement – and what they learned about ocean observing systems in the process:

- ▼ The University of Waterloo reported on the VENUS project, which was fitting as they are a Canadian team and the Victoria Experimental Network Under the Sea, or VENUS, is a cabled observatory being installed in the Strait of Georgia, off the coast of British Columbia.
- ▼ The Dana Middle School from Hawthorne, CA focused on a career opportunity associated with Monterey Accelerated Research Systems, or MARS. The team related what they were tasked to do for the competition to the real-life tasks that ROV operators are carrying out as they install instruments on the seafloor of the Monterey Canyon.
- ▼ Missouri State University looked at the big picture by summarizing information about the Integrated Ocean Observing System, or IOOS. IOOS is made up of 11 regional associations (RAs) that cover our coasts and include the Caribbean and Pacific Islands.
- ▼ Alpena High School in Alpena, MI looked at an even bigger picture – the team reported on the Global Ocean Observing System, or GOOS, and the worldwide cooperative effort that it’s taking to make it a reality.

During the competition, the teams also participated in engineering evaluations where they explained to a panel of judges how their vehicle works, including how it was built to accomplish the mission tasks. Following the presentation was a question and answer session where the judges asked the teams for more details and/or to clarify information. The judges represented a wide range of fields – science, industry, government, and the military – which helped the students to see the multitude of ocean-related career opportunities that are available to them.

These “engineering and communication” components of the competition are designed to underscore the importance of written and oral communication as well as the importance of

good documentation and project management. The hope is that students come to appreciate that the ability to effectively communicate ideas and manage people, time, and resources is equally important as how well their vehicle performs!

REGIONAL CONTEST NETWORK

The 2006 international competition was held at the NASA Johnson Space Center's Neutral Buoyancy Lab, helping to highlight NASA's role in observing our oceans from space via satellites. The event took place June 23 – 25, with the underwater missions staged in the facility's 6.2-million gallon astronaut training pool. The student-built ROVs, some smaller than one square meter, were quite a contrast to the full-sized mock-ups of the space shuttle and International Space Station that are secured to pool's bottom. These are the mock-ups that the astronauts use to prepare for their EVAs (extravehicular activities).

In addition to the annual international competition, thirteen regional contests took place. From Hong Kong to Newfoundland, the regional competition network helped to accommodate the ever-growing interest in the competition program, allowing more and more students and educators to take part in this exciting educational experience.

The following is a list of the 2006 regional contests and the organizations that organized and supported them:

- ▼ The Southern California ROV Fly-Off was organized by the Birch Aquarium at Scripps Institution of Oceanography (SIO), with support from SIO, the MTS-San Diego section, and the University of California San Diego's Jacobs School of Engineering.
- ▼ The Texas Regional ROV Contest was organized by Alvin Community College (ACC) and the NASA JSC with support from the MTS-Houston section and the Flower Garden Banks National Marine Sanctuary.
- ▼ The New England Regional ROV Contest was organized by the MTS-New England section and supported by the section, the University of Connecticut, and Stellwagen Banks National Marine Sanctuary.
- ▼ The Monterey Bay Regional Contest was organized by the MATE Center, with support from Monterey Peninsula College's (MPC) Technology Preparation Program, the MPC Foundation, MBARI, the MTS-Monterey section, and the Monterey Bay National Marine Sanctuary.
- ▼ The Hawaii Underwater Robot Challenge (HURC) was organized by the University of Hawaii (UH) Manoa and Waipahu High School and supported by the UH's Seafloor Mapping Lab and the MTS- and IEEE-Hawaii sections.
- ▼ The Florida Regional ROV Contest was organized by Hillsborough Community College with support from the college, the MTS-Florida section, and Busch Garden's Adventure Island amusement park.
- ▼ The Great Lakes Regional ROV Contest was organized by Thunder Bay National Marine Sanctuary & Underwater Preserve and supported by the National Oceanic and Atmospheric Administration's (NOAA) Great Lakes Environmental Research Lab and Lake Superior State University.
- ▼ The Big Island Regional ROV Contest (BIRR) was organized by Kealekahe High School and the Hawaii Island Economic Development Board's Women in Technology Program (WIT) and supported by WIT and the MTS-Hawaii section.
- ▼ The Northern California Regional ROV Contest was organized by Arcata, Eureka, and McKinleyville High Schools with support from Humboldt State University.
- ▼ The Puget Sound Regional ROV Contest was organized and supported by the MTS- and IEEE Oceanic Engineering Society-Puget Sound sections, the Naval Undersea Museum, and the Youth Maritime Training Association.
- ▼ The Mid-Atlantic Regional ROV Contest was organized and supported by the *Monitor* National Marine Sanctuary, Nauticus National Maritime Center, and NOAA's Maritime Heritage Program.
- ▼ The Southeast Regional ROV Contest was organized and supported by Gray's Reef National Marine Sanctuary and the Georgia Aquarium.
- ▼ The Newfoundland and Labrador Regional ROV Contest was organized by Memorial University of St. John's Newfoundland.
- ▼ The Hong Kong Underwater Robot Challenge was organized and supported by the City University of Hong Kong and the WWF (Worldwide Fund for Nature).

THE POWER OF PARTNERSHIP

In addition to providing background information and resources for developing the mission scenario, working with Ocean.US and the ORION Program allowed the MATE Center to provide the teams with opportunities that further complemented the theme and supported them in the design and building process. For example, MATE and Ocean.US worked to connect the 11 RAs that make up the IOOS network with existing teams. The goal was to engage the organizations and working professionals involved in the RAs as team mentors and to encourage them to provide access to facilities,

parts and supplies, and possibly funds and training opportunities for individual teams and instructors.

In addition to Ocean.US and the ORION Program, the 2006 competition was supported by nearly 80 organizations and 100+ working professionals who donated funds, facilities, equipment, building materials, time, and technical expertise. These organizations included the National Science Foundation and NOAA's Office of Ocean Exploration, both of which provided funding to support the competition. Major players in the offshore industry, such as Oceaneering International, Sonsub, and Perry Slingsby Systems, also contributed funds. Professional societies like MTS and the Institute of Electrical and Electronics Engineers' (IEEE) Oceanic Engineering Society also provided financial support.

Engineers and ROV pilots from organizations such as the Monterey Bay Aquarium Research Institute (MBARI), Deep Marine Technology, and Canyon Offshore, among others volunteered as competition judges. Professionals from these organizations and others, such as Phoenix International, also shared their time and talents as mentors to the local teams. Companies such as VideoRay and Sound Ocean Systems offered teams hardware and supplies at low (or no) cost.

Through the support that these organizations provide, the competitions are increasing awareness of career opportunities and infusing expertise (through access to industry mentors, equipment, and facilities) into educational programs where it is desperately needed. What better way for students to learn about ocean occupations than by working side-by-side with individuals currently in the workplace. And what better way to help educators deliver hands-on, real world learning experiences than by complementing and building upon what they are teaching in the classroom and providing access to materials and facilities often unavailable to educational programs.

COSEE OCEAN CAREER EXPO

Increasing student awareness of and access to ocean-related career opportunities is an overarching goal of the competition program, as is providing ocean employers with access to skilled individuals who can meet their workforce needs. To help accomplish these goals, this year the MATE Center and its Center for Ocean Sciences Education Excellence (COSEE) California¹ partners organized an "Ocean Career Expo" that took place in conjunction with the international competition. The Ocean Career Expo was designed to highlight ocean career opportunities; connect students with employers; and help employers find skilled employees.

¹ COSEE is an NSF initiative designed to foster the involvement of ocean scientists, technicians, and engineers in ocean science education. COSEE-California partners include the MATE Center, Scripps Institution of Oceanography (SIO), the Birch Aquarium at SIO, California Sea Grant, and the Lawrence Hall of Science at the University of California Berkeley.

Competition students, especially those about to graduate or looking for employment, were encouraged to submit résumés in advance so that they could be circulated to the sponsoring organizations invited to participate. MTS ROV Committee Chairman Drew Michel helped to set the stage for the Expo and put it into perspective when he presented an overview of the ocean workforce at the competition's kick-off reception.

During the Expo, competition sponsors such as Oceaneering International, Schilling Robotics, Deep Marine Technology, Acergy, OceanWorks, and Shell Exploration and Production showcased their companies and career opportunities. Students had the opportunity to speak with the representatives of these organizations to learn more about current job openings, while the representatives had the opportunity to informally interview the students for those positions. NOAA National Ocean Sciences' Captain Craig McLean completed the Ocean Career Expo and the ocean workforce picture when he addressed students during the closing awards ceremony.

The MATE Center will monitor the impact of the Ocean Career Expo to determine if it served its purpose—that is, students with jobs and companies with new employees!

2006 AND BEYOND

By focusing on ocean observing systems, MATE's goal was to increase awareness and understanding of the scientific, technological, and operational aspects of these systems and the impact they have on society and the economy. More than that, through the involvement of Ocean.US and ORION and events such as the COSEE Ocean Career Expo, the goal was to network working professionals and potential employers with students who may one day become the workforce that develops, deploys, operates, and maintains ocean observatories and uses them to better understand and explore our oceans.

In this way, the MATE Center, the MTS ROV Committee, and its partners throughout the world are continuing to work to bridge the gap between education and the workplace and help meet the challenge of preparing qualified individuals to meet workforce needs.

ACKNOWLEDGEMENTS

The MATE Center and the MTS ROV Committee thank the many industries, research institutions, professional societies, government agencies, and working professionals that supported the 2006 competition. Without their contributions the competition could not have taken place. The Center and the Committee also thank the NASA JSC's NBL for hosting the international competition for the second year in a row. We are extremely grateful for the opportunity to bring students and their instructors to such a spectacular facility. Finally, MATE and the ROV Committee extend their appreciation and gratitude to Ocean.US and the ORION Program for helping us to bring the excitement and promise of ocean observing systems to students around the world.

REFERENCES

- [1] U.S. Commission on Ocean Policy. *An Ocean Blueprint for the 21st Century*. Final Report, Washington, DC, 2004.
- [2] Vice President Al Gore, Opening Address (from the Cross-Cutting Issues Plenary Session), National Ocean Conference, June 11-12, 1998, Monterey, California.
- [3] Sullivan, Deidre, Tom Murphree, Bruce Ford, Jill Zande. "Ocean Careers: Navigating Your Way to a Better Future." *Marine Technology Society Journal*, Vol. 39, No. 4.
- [4] Zande, Jill and Deidre Sullivan. "Student ROV Competitions: Helping to Build Your Future Work Force" [Paper]. Underwater Intervention (UI) International Conference, February 10-12, 2003 New Orleans, LA.
- [5] Marine Technology Society (MTS) President Jerry Streeter's "State of the Society" address presented at the 2005 MTS/Institute of Electrical and Electronics Engineers (IEEE) Oceans Conference, September 19-23, 2005, Washington, DC.